



## CIRCUIT BOARD HOLDERS AND ASSEMBLIES

### Field of the Invention

The subject invention relates to circuit board holders and circuit board assemblies.

### Background

The utility of printed and other circuit boards is well known.

In the field of circuit breakers, the art has evolved progressive methods and circuit breaker housings for conveniently mounting circuit breakers in corresponding apertures of power switching panels, such as apparent from United States Patent No. 4,812,793, by Bohdan Krasij, issued March 14, 1989 for "Circuit Breaker Housing With Centered Actuator." Circuit breaker housings such as shown in Fig. 9 of that patent have been and are being sold as "dummies" for covering up panel apertures where no circuit breaker is being mounted at the time. Commercial versions of such dummies accommodate different mounting panel thicknesses by serrations at ends of so-called wings 220c shown in that patent.

In the circuit board field, there exists a need for improved circuit board holders and assemblies. By way of example and not by way of limitation, the need is particularly pressing in applications requiring rapid circuit board replacements, preferably without power interruption. One example in this respect is the alarm circuit field, such as in telephone exchange and the like, where circuit boards of alarm systems need to be replaced without disruption of power to distribution circuits.

34

35

36

1

2                   Summary of the Invention

3

4         It is an object of the invention to provide improved  
5 methods of making circuit board holders.

6         It is a germane object of the invention to provide  
7 improved circuit board holders.

8         It is a related object of the invention to provide  
9 improved methods of making circuit board assemblies.

10        It is a related object of the invention to provide  
11 improved circuit board assemblies.

12        Other objects will become apparent in the further  
13 course of this disclosure.

14        From a first aspect thereof, the invention resides in  
15 a method of making a circuit board holder and, more  
16 specifically, resides in the improvement comprising, in  
17 combination, providing that circuit board holder with a  
18 face plate and with walls projecting from an inside of  
19 that face plate, equipping a pair of opposite ones of such  
20 walls with circuit board retainers and equipping that  
21 circuit board holder with a holder retainer for releasably  
22 retaining that circuit board holder in the mentioned  
23 aperture of the panel.

24        From a related aspect thereof, the invention resides  
25 in a circuit board holder comprising, in combination, a  
26 face plate and walls projecting from an inside of that  
27 face plate, circuit board retainers at a pair of opposite  
28 ones of such walls, and a holder retainer at an edge of  
29 the face plate.

30        The circuit board retainers may be inside and/or  
31 outside of the circuit board holder.

32        From another aspect thereof, the invention resides in  
33 a method of mounting a device, such as a circuit board  
34 holder, in an aperture of a panel, comprising, in

1 combination, providing that device with a resilient snap  
2 for releasably retaining that device in the panel at that  
3 aperture, providing the panel with a slot at that aperture  
4 for access to the resilient snap through that panel, and  
5 releasing such resilient snap through that slot for  
6 removal of the device from the panel.

7 From a related aspect thereof, the invention resides  
8 in a combination of a panel having an aperture, a device,  
9 such as a circuit board holder, retained in that aperture  
10 by a resilient snap at an edge of that aperture, and a  
11 slot in such panel at that aperture exposing the resilient  
12 snap through the panel at an edge of the mentioned  
13 aperture in that panel.

14 Embodiments of the invention extend to assemblies of  
15 such circuit board holders with circuit boards therein and  
16 with circuit panels.

17

18 Brief Description of the Drawings

19

20 The subject invention and its various aspects and  
21 objects will become more readily apparent from the follow-  
22 ing detailed description of preferred embodiments thereof,  
23 illustrated by way of example in the accompanying drawings  
24 which also constitute a written description of the  
25 invention, wherein like reference numerals designate like  
26 or equivalent parts, and in which:

27 Fig. 1 is a perspective view of a circuit board  
28 holder according to an embodiment of the invention;

29 Fig. 2 is a longitudinal section through the circuit  
30 board holder according to Fig. 1, with an inserted circuit  
31 board according to a further embodiment of the invention,  
32 and with such circuit board assembly releasably retained  
33 in a corresponding aperture of a panel;

34 Fig. 3 is an exploded view of a circuit board

1 assembly showing insertion of a circuit board into a  
2 circuit board holder according to a related embodiment of  
3 the invention;

4 Fig. 4 is a top view of that circuit board assembly;

5 Fig. 5 is a top view of a fraction of a panel for  
6 mounting a circuit board holder or similar device  
7 according to an embodiment of the invention; and

8 Fig. 6 is a view similar to Fig. 5 with a section  
9 through an inserted circuit board holder or similar device  
10 and through a release tool pursuant to an embodiment of  
11 the invention.

12

13

14 Modes of Carrying Out the Invention

15

16 The drawings illustrate methods of making circuit  
17 board holders, improved circuit board holders and  
18 assemblies of such circuit board holders with circuit  
19 boards therein, pursuant to the subject invention and  
20 embodiments thereof.

21 Methods of making a circuit board holder 10,  
22 according to embodiments of the invention for installation  
23 in an aperture 12 of a power panel 13, provide that  
24 circuit board holder with a face plate 14 larger than that  
25 aperture and with walls 16, 17, 18 and 19 projecting from  
26 an inside 20 of that face plate. Those embodiments of the  
27 invention equip a pair 16 and 18 of opposite ones of the  
28 walls 16, 17, 18 and 19 with circuit board retainers 21  
29 and 22 and/or 33 and 34. Those embodiments of the  
30 invention further equip the circuit board holder 10 with a  
31 holder retainer 23 for releasably retaining that circuit  
32 board holder in the mentioned aperture 12 of the panel 13.

33 Plastics material molding or other well-known  
34 manufacturing techniques may be employed for making the

1 circuit board holders herein disclosed.

2 In apparatus terms, a circuit board holder 10  
3 according to an embodiment of the invention installable in  
4 the aperture 12 of panel 13 according to the illustrated  
5 embodiments of the invention comprises a face plate 14  
6 larger than that aperture 12 and walls 16, 17, 18 and 19  
7 projecting from the inside 20 of that face plate, circuit  
8 board retainers 21 and 22 and/or 33 and 34 at a pair of  
9 opposite ones of such walls, such as walls 16 and 18, and  
10 a holder retainer 23 at an edge 25 of the face plate.  
11 Such holder retainer may be spaced from that face plate by  
12 a distance corresponding to a thickness 26 of the panel,  
13 such as seen in Fig. 2 showing an assembly of the circuit  
14 board holder 10 with a panel 13 and a circuit board 28.

15 At least one of another pair of the walls 16 to 19  
16 may be provided with or has a lateral opening covering at  
17 least one half of that wall. Fig. 1 by way of example  
18 shows both pairs of walls 17 and 18 with such lateral  
19 openings 30 and 31 providing, for instance, access to one  
20 or more installed circuit boards 28, such as for cooling  
21 air and the like, or for other purposes. In that case,  
22 the space 20 is still inside the circuit board holder.

23 Within the scope of the invention, various devices  
24 and features may be used as circuit board retainers. By  
25 way of example and not by way of limitation, circuit board  
26 retainers may be provided internally of the space 20  
27 inside the circuit board holder 10, such as seen at 21 and  
28 22, and may therefor be termed "internal circuit board  
29 retainers." Alternatively or preferably additionally,  
30 circuit board retainers may be provided externally of the  
31 inside space 20, such as seen at 33 and 34, and may  
32 therefor be termed "external circuit board retainers."

33 Accordingly to the embodiments of the invention shown  
34 in Figs. 2 to 4, a circuit board 28 or 280 is inserted

1 into the circuit board holder 10. The inserted circuit  
2 board 28 or 280 is substantially retained in a first  
3 direction inside of the circuit board holder, such as with  
4 internal circuit board retainers 21 and 22, and is  
5 substantially retained in a second direction, such as  
6 transversely to that first direction, externally of the  
7 inside space 20 of the circuit board holder, such as with  
8 external circuit board retainers 33 and 34.

9       The circuit board retainers 21 and 22, according to  
10 the illustrated embodiment of the invention, include or  
11 are shaped as spaced rails for slideably receiving a  
12 circuit board 28 or 280. In this respect, Figs. 1 and 3  
13 show several such circuit board retainers or spaced rails  
14 21 and 22 in each of the pair of opposite walls 16 and 18,  
15 respectively, for slideably receiving at least one circuit  
16 board 28 at one of several levels in the circuit board  
17 holder. Alternatively, two or more circuit boards may be  
18 accommodated in one circuit board holder 10.

19       According to the illustrated embodiment of the  
20 invention, the circuit board holder 10 has or is provided  
21 with external circuit board retainers 33 and 34 in  
22 addition to the internal circuit board retainers 21 and  
23 22.

24       Also according to the illustrated embodiment of the  
25 invention, the pair of opposite walls 16 and 18 has or is  
26 provided with extensions 36 and 37 beyond the inside 20 of  
27 the circuit board holder 10. Such extensions 36 and 37  
28 are equipped with circuit board retainers, or such circuit  
29 board retainers 33 and 34 are on these extensions 36 and  
30 37, respectively.

31       By way of example, as illustrated in Figs. 2 and 4,  
32 the circuit board 28 is releasably retained with circuit  
33 board retainers inside of the circuit board holder 10 and  
34 is stabilized in that circuit board holder.

1        Notwithstanding such terminology, the external  
2 circuit board retainer 33 and 34 may serve as circuit  
3 board stabilizers and may serve the purpose of retaining  
4 circuit boards 28 and 280 in the circuit board holder, or  
5 the retainers 21 and 22 and 33 and 34 may jointly retain  
6 and stabilize the circuit board in the circuit board  
7 holder.

8        As seen in Figs. 1 and 2, the circuit board holder 10  
9 according to an embodiment of the invention has or is  
10 equipped with accommodations 38 and 39 at rails 21 and 22,  
11 respectively. Such accommodations 38 and 39 may be a  
12 narrowing of the holder structure permitting the holder  
13 retainers 23 and 24 to be bent inwardly for a release of  
14 the circuit board holder 10 from the panel 13.

15      Alternatively or additionally, the accommodations 38  
16 and 39 may in effect be circuit board stops at a distance  
17 40 from a rear of the face plate 14.

18      Within the scope of the invention, the circuit board  
19 28 may be provided with a frontal portion 51 of reduced  
20 width relative to a subsequent main portion 52 of that  
21 circuit board. Such circuit board may be inserted in the  
22 circuit board holder 10 by inserting the frontal portion  
23 51 of reduced width in between the spaced external circuit  
24 board retainers 33 and 34 and by thereupon forcing apart  
25 such spaced circuit board retainers with the main portion  
26 52 of the circuit board and by continuing insertion of the  
27 circuit board into the circuit board holder so that the  
28 circuit board is releasably retained with the internal  
29 circuit board retainers 21 and 22 inside of the circuit  
30 board holder and is stabilized in that circuit board  
31 holder with the external circuit board retainers and  
32 stabilizers 33 and 34.

33      By way of example, the external circuit board  
34 retainers and stabilizers 33 and 34 may be forced apart by

1 flexure of the wall extensions 36 and 37.

2 In this or any other manner within the scope of the  
3 invention, the circuit board holder includes an inserted  
4 circuit board 28 or 280 extending across that circuit  
5 board holder between the pair of opposite walls 16 and 18  
6 and circuit board retainers 21 and 22. Such inserted  
7 circuit board preferably also extends between the circuit  
8 board retainers or stabilizers 33 and 34, such as shown in  
9 Figs. 2 and 4.

10 According to the embodiment of the invention shown in  
11 Figs. 3 and 4, one or more circuit board stops 380, such  
12 as at the kind of distance 40 shown in Fig. 1 from a rear  
13 of the face plate 14, may be provided in the circuit board  
14 holder for stopping insertion of a circuit board 280 at a  
15 leading edge or corner 55. Alternatively or additionally,  
16 catches 133 and 134 corresponding to the external circuit  
17 board retainers 33 and 34, respectively, may be provided  
18 in the circuit board, such as seen in Fig. 3, in order to  
19 retain an inserted circuit board in a predetermined  
20 position, such as shown in Fig. 4.

21 In apparatus terms, an inserted circuit board 280 has  
22 lateral catches 133 and 134 externally of a space 20  
23 inside a circuit board holder which has extensions 36 and  
24 37 of a pair of opposite walls 16 and 18, and circuit  
25 board retainers 33 and 34 are on those extensions and  
26 lateral catches.

27 According to the embodiment shown in Figs. 3 and 4,  
28 these catches 133 and 134 are lateral notches in the  
29 circuit board 280 into which the external circuit board  
30 retainers 33 and 34 come to rest when the circuit board is  
31 completely inserted into its holder. However, within the  
32 scope of the invention, different forms of retainers and  
33 catches than those illustrated in the drawings may be  
34 employed at 33/133 and 34/134. For instance, instead of

1 being concave as shown in Figs. 3 and 4, the catches 133  
2 and 134 may, for instance, be convex, and the external  
3 retainers 33 and 34 may be correspondingly concave so as  
4 to receive such convex catches.

5 Within the scope of the invention, the wall  
6 extensions 36 and 37 and external circuit board retainers  
7 33 and 34 may be subdivided into external circuit board  
8 retaining fingers that may alternate with the internal  
9 circuit board retainer rails or shelves 21 and 22.

10 The above mentioned holder retainer 23 preferably is  
11 or is shaped as a resilient snap for releasably retaining  
12 the circuit board holder 10 in the aperture 12 of the  
13 panel 13. As seen in the drawings, such holder retainer  
14 may include or be shaped as a pair of resilient snaps 23  
15 and 24 at the pair of opposite walls 16 and 18 for  
16 releasably retaining the circuit board holder in aperture  
17 12 of panel 13.

18 By way of example and not by way of limitation, such  
19 snaps 23 and 24 may be the so-called wings 220c shown in  
20 the above mentioned United States Patent No. 4,812,793 for  
21 circuit breaker housings.

22 As seen in Figs. 1 to 3, there may be one or more  
23 apertures 42 in the face plate 14, and a signal lamp 43  
24 may be in any or each of those apertures and may be  
25 connected to the circuit board 28, for instance. Such  
26 apertures 42 may be of a knock-out type, being covered in  
27 the face plate 14 until needed.

28 By way of example and not by way of limitation, the  
29 circuit board 28 is shown with components 45, circuitry  
30 48, and terminals 49, and similar components may, of  
31 course, be provided in the circuit board 280.

32 Figs. 2, 5 and 6 show provision of the panel 13 with  
33 an aperture 12 for receiving the circuit board holder 10.  
34 According to an embodiment of the invention illustrated

1 in Figs. 5 and 6, the panel 13 is provided with a slot 56  
2 at the aperture 12 for access to the holder retainer or  
3 resilient snap 23 through that panel 13. That embodiment  
4 of the invention also effects release of the holder  
5 retainer 10 through the slot 56 for removal of the circuit  
6 board holder from the panel.

7 In this respect, Fig. 5 shows the circuit board  
8 holder 10 only by a dotted outline of its face plate 14 so  
9 as to avoid obstruction of the aperture 12 with lateral  
10 slot extensions or slots 56 and 57. Conversely, Fig. 6  
11 shows the circuit board holder 10 in section through its  
12 walls 16 to 19 behind its face plate. In Fig. 6, most of  
13 the holder retainers or resilient snaps 23 and 24 are  
14 covered up by the panel 13 and are therefore shown by  
15 dotted lines, except where they cross under the slots 56  
16 and 57.

17 In apparatus terms, the panel 13 has an aperture 12  
18 adapted to receive the walls 16 to 19 of the circuit board  
19 holder 10 behind the face plate 14 seen in Figs. 1 to 5.  
20 A slot 56 in that panel at that aperture exposes the  
21 holder retainer or snap 23 through the panel at an edge of  
22 that aperture 12 in the panel.

23 In Figs. 5 and 6, the components 14, 16 to 19, 23 and  
24 if present may signify a device other than a circuit  
25 board holder. Accordingly, Figs. 5 and 6 may be seen as  
26 illustrating a method of mounting a device, such as a  
27 circuit board holder, in an aperture 12 of a panel 13,  
28 comprising, in combination, providing that device with a  
29 resilient snap 23 for releasably retaining that device in  
30 the panel at that aperture, providing the panel with a  
31 slot 56 at that aperture for access to the resilient snap  
32 23 through that panel, and releasing such resilient snap  
33 through that slot for removal of the device from the panel  
34 13.

1       In this respect, Figs. 5 and 6 also illustrate a  
2 combination of a panel 13 having an aperture 12 and a  
3 device, such as a circuit board holder 10, retained in  
4 that aperture by a resilient snap 23 at an edge of that  
5 aperture, and a slot 56 in such panel at that aperture  
6 exposing such resilient snap through the panel at an edge  
7 of the mentioned aperture in that panel 13.

8       As seen in Fig. 6, the embodiment of the invention  
9 currently under consideration also provides a tool 58  
10 insertable through slot 56. By way of example and not by  
11 way of limitation, the tool 58 may be a screwdriver or  
12 similar device which has a blade or similar implement  
13 having lateral dimensions smaller than the slot 56 so as  
14 to be insertable therein and therethrough to the holder  
15 retainer or resilient snap 23. In this or any other  
16 manner within the scope of the invention, the holder  
17 retainer or resilient snap 23 may be released with a tool  
18 56 insertable through slot 56. Such release, may, for  
19 instance, be effected by depression of the resilient snap  
20 23 toward the device 10 or its wall 16, until the  
21 depressed snap 23 clears the aperture 12 for a removal of  
22 the circuit board holder 10 or other device from the panel  
23 13.

24      According to an embodiment of the invention, the  
25 holder retainer 23 is provided with steps or serrations  
26 230 for mounting the circuit board holder 10 in different  
27 mounting panels, including the mounting panel 13 of  
28 thickness 26 such as shown in Fig. 2 and mounting panels  
29 of other thicknesses, such as seen also in Fig. 6.

30      In principle, and within the scope of the invention,  
31 there need only be one holder retainer or resilient snap  
32 23, in which case only one lateral slot 56 and only one  
33 release tool 58 is required. However, where there are a  
34 pair of resilient snaps 23 and 24 at the pair of opposite

1 walls 16 and 18, such as shown in Figs. 1 to 4, for  
2 releasably retaining a circuit board holder 10 or similar  
3 device in the aperture 12 of a panel 13, such as shown in  
4 Figs. 2, 5 and 6, then there need to be a pair of  
5 corresponding slots 56 and 57 and a pair of corresponding  
6 tools 58 and 59 for a simultaneous release or depression  
7 of both resilient snaps 23 and 24, such as seen in Fig. 6  
8 for the desired removal of the device 10 from the panel  
9 13. There also may be panel-accommodating serrations 230  
10 and 240 in each holder retainer or resilient snap 23 and  
11 24, respectively.

12 Accordingly, pursuant to conventional patent  
13 practice, expressions such as "a slot" and "a tool"  
14 employed in this description and in accompanying claims  
15 implicitly stand for "at least one slot" and "at least one  
16 tool," respectively, extending to a provision or  
17 utilization of two slots, such as shown at 56 and 57 and  
18 two release tools, such as shown at 58 and 59 in Fig. 6,  
19 for instance.

20 This extensive disclosure will render apparent or  
21 suggest to those skilled in the art various modifications  
22 and variations within the spirit and scope of the  
23 invention.

24

25

26

27

28

29

30

31

32

33

34